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Purpose of this Presentation

- Discuss chromium toxicity
- Explain the general process for developing PHGs
- Discuss why we based our PHG on a level that protects against cancer
- Describe the meaning of the PHG

Two Primary Environmental Forms of Chromium

Trivalent chromium (Cr III)

- Not very toxic
- An essential dietary nutrient

Hexavalent chromium (Cr VI)

- The most toxic form of chromium
- The primary basis for our health levels for chromium

Primary Toxic Effects of Hexavalent Chromium Exposure

- Multiple toxic effects which can cause death after large single doses
- Immune sensitization in rats
- Contact dermatitis in humans
- Testicular degeneration and decreased sperm count in male mice
- Reproductive and developmental toxicity in mice.
- Cancer in animals and humans after prolonged exposures

Cancer Effects of Hexavalent Chromium

- Cr VI is classified as a “known human carcinogen”
- Cr VI causes lung cancers in occupational exposures
- Cr VI also caused other tumors (stomach, liver) in occupationally exposed humans
- Cr VI damages DNA and is mutagenic
- Cr VI in drinking water caused stomach cancer in mice

Reasons for Considering Hexavalent Chromium as an Oral Carcinogen

- The general public health approach is that chemicals which produce cancer by one route of exposure must be assumed to produce cancer by other routes, unless there is compelling evidence to the contrary
- The evidence in this case is that both inhalation (human) and oral (experimental animals) routes can lead to cancer
- Some evidence of excess cancers of the digestive tract and liver in chromium workers
- Cr VI can enter cells to damage DNA

Public Health Goals (PHGs) for Chemicals in Drinking Water

- Established by the California Safe Drinking Water Act of 1996 (Health and Safety Code Sec. 116365)
- OEHHA is required to perform risk assessments and publish Public Health Goals (PHGs) for drinking water contaminants
- PHGs must be based exclusively on public health considerations
- PHG documents are available on the web at:
<http://www.oehha.ca.gov>

PHGs are Being Developed:

- For chemicals with an established Maximum Contaminant Level (MCL)
- When requested by the DHS or the legislature
- In this case an MCL exists for total chromium, not hexavalent chromium

Public Health Goals (PHGs) are:

- Estimates of the levels of chemicals in drinking water that would pose no significant health risk over a lifetime of exposure
- Determined through a comprehensive literature review and scientific evaluation, according to standard risk assessment procedures
- Subject to extensive internal and external scientific peer review and public review and comments
- Non-regulatory guidance values, considering only health effects
- To be used by California DHS as one of the inputs for setting MCLs for chemicals in drinking water.

Public Health Goals (continued)

- PHG values provided information which can be used to determine health protective values and guide risk managers
- To protect against cancer, the PHG is the level estimated to cause no more than one cancer case in one million people exposed for a lifetime
- One in a million is considered an extremely small or negligible risk level
- To protect against non-cancer effects, the PHG is set at a concentration at which no toxic effects are expected, including an adequate margin of safety
- PHGs must consider sensitive populations, other contaminants, and all exposure routes
- If information is inadequate to establish a safe level, the PHG may be set at zero

Public Health Goals (continued)

The chromium PHG was developed to:

- Protect against cancer and all other health effects

It is based on:

- A study in mice given hexavalent chromium (Cr VI) in their drinking water
- Benign and malignant stomach tumors occurred in the mice
- A risk assessment cancer model which assumes no threshold for cancers was used in the calculation

Calculation of the Chromium PHG

- First we calculated the risk of exposure to hexavalent chromium, taking into account the cancer potency and assuming people drink 2 liters of water per day for their lifetime
- To obtain the PHG for total chromium, we had to consider how much of the hexavalent form would be found in water
- Based on the 1998 data, we assumed 7% of total chromium would be hexavalent
- This resulted in a PHG of 2.5 ppb for total chromium
- The level based on cancer was judged to be low enough to protect against all non-cancer effects, with an adequate margin of safety.

What if PHG levels are exceeded?

- Estimated health risk could exceed a "negligible" level, but still pose a very small risk
- Risk estimates assume a whole lifetime of exposure
- The PHG is not a "bright line," but more of a guide post
- Development of MCLs by DHS will consider the estimated risk, along with economics and feasibility
- Exceedance reports must be published by water agencies

Summary of chromium PHG development

- Required under California Safe Drinking Water Act of 1996, based only on public health considerations
- Comprehensive literature review and data evaluation, subjected to extensive peer review.
- Developed in 1998, published in 1999 using Cr VI to Cr III ratio data available at that time.
- Estimated health-protective level for total chromium is **2.5 ppb**, based on a risk estimate of not more than one cancer case in one million people exposed for a lifetime.
- Includes adequate margin of safety to protect against all other potential health effects.